Microbiological studies in burns

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CHAPTER 11

Summary and conclusions

The severely burned patient undergoes complex physiological and metabolic changes over the course of the injury. Resucsitation will be the main goal of the treatment in the first phase. Those patients who survive that first phase, are prone to infections till the goal of the therapy has been reached: i.e. the permanent closure of the wound.

In chapter 2, the immunological consequences of trauma are discussed. Shortly after the accident, nearly all components of the immunological system are depressed. Several factors have been postulated to be responsible for this immunosuppression. Although immunosuppression in severely burned patients is most probably multifactorial endotoxin from aerobic Gram-negative rods may be an important inducer of this immunosuppression.

In chapter 3, the infectious complications are discussed. The most important microorganisms involved are *Pseudomonas aeruginosa*, Enterobacteriaceae and to a lesser extent *Staphylococcus aureus* and yeasts.

Immediately after the burn, the wound is essentialy sterile. Wound colonization is predominated by Gram-positive microorganisms in the first few days. At the end of the first week and in the second and third week, Gram-negative rods, from enteric origin colonize the wounds. At least in about 30% of the patients, *Ps.aeruginosa* may colonize the wounds. Although this microorganism may colonize the gastro-intestinal tract, it is well-known that in severely ill patients the gastro-intestinal colonization pattern may be changed. In this situation the fecal carriage incidence of *Pseudomonas* has been reported to be as high as 50%. The use of broad spectrum antibiotics together with endotracheal intubation will increase the likehood of colonization with *Pseudomonas*.

Although the use of topical antimicrobials and the application of strict hygienic policies has lowered the incidence of infections in severely burned patients, infectious complications continue to be an important cause of mortality in burns. One of the reasons for this is that strict hygienic policies which avoid cross-contamination, do not avoid auto-contamination of the wound with fecal microflora.

Another reason may be: the dissemination of microorganisms by means of translocation. Translocation is discussed in chapter 4. Several factors may influence bacterial translocation, however, on the basis of experimental findings these different factors can be divided into two major groups:

1. Experiments, dealing with a disruption of the normal intestinal microflora either by orally administered bacteria or by administration of antimicrobial substances which decrease colonization resistance and lead to "overgrowth" of the aerobic fecal microflora.
2. Experiments in which animals have a decreased defence capacity due to immunosuppression, trauma or shock.

Although there are convincing data, it is difficult to prove translocation in the clinical situation. In granulocytopenic patients, a clear correlation between the dominant bacterial species in the feces and the development of Gram-negative bacteremia has been shown. Thus, if translocation is an important clinical cause of bacteremia, a treatment approach could be selective decontamination (SDD) of the digestive tract.

SDD has proved to be successful in preventing infections in severe granulocytopenic patients. In the last few years, SDD has been used in other patient categories -such as patients staying in IC units- however, till now there is still no agreement about its efficacy in these patients.

In chapter 6 the results of the use of SDD in severely burned patients is discussed. The use of SDD in 48 patients resulted in a low incidence of infections in this group of patients (15%). Only two patients (41%) died with evident clinical signs of infection (25% of all deaths in burns versus 60 to 70% in the literature).

From this study, it appears that SDD can prevent infections in patients with severe, extensive burns. However, because the study was not prospective and randomized, the proof that SDD prevents infections in burns still has to be carefully studied. Also other factors may influence the rate of septic complications in a particular center, such as the ventilation systems in the burn unit, hygienic policies, definition of infection, and the discipline of the staff as well as the use of enteral or parenteral feeding.

In chapter 7 the influence of orally administered aztreonam on the bacterial colonization of the wound is investigated in experimentally burned mice. Mice treated for 20 days post burn with oral aztreonam had significantly reduced enterobacterial wound colonization compared to untreated controls.

In chapter 8 the effect of SDD on wound colonization in 69 severely burned patients was examined. In nearly all cases prior to wound colonization with enterobacterial species and yeasts, the same microorganism was isolated from the gastro-intestinal tract. When SDD did successfully eliminate the aerobic Gram-negative rods and yeasts from the gastro-intestinal tract, wound colonization with these microorganisms appeared to be rare.

The colonization of a burn wound with a variety of microorganisms is generally accepted as relatively harmless for wound healing and graft survival. From the microbiological viewpoint, it is improbable that many of these microorganisms -with their toxins- should not influence

wound healing. In chapter 9 the relation between wound colonization and wound healing is discussed.

Because of the fact that measuring wound healing in the clinical situation is very difficult and the fact that patients are discharged when wounds are completely healed, we investigated the relation of the duration of hospital stay and wound colonization. By means of Cox model survival analysis, it appeared that colonization with Enterobacteriaceae and the combination of *Pseudomonas* species with *S.aureus* was related to a longer duration of hospitalization. So colonization with certain microorganisms has a poor prognosis as to the length of hospital stay. The role of microbes at the level of wound healing and hypertrophic scarformation should be subject of further study.

In chapter 10 the influence of *Ps.aeruginosa* wound colonization in experimentally burned mice is described. The conclusions of this experiment are, that dissemination by means of translocation exceeds the importance of dissemination of microorganisms from the infected wound and that wound colonization with *Ps.aeruginosa* induces an enhanced degree of translocation. Further investigations are required to explain the mechanisms responsible for this enhanced translocation and the possible interventions to prevent septic complications caused by translocating microorganisms.

Hoofdstuk 1:

Hoofdstuk 2:

Hoofdstuk 3:

The conclusions of this thesis are:

- the burn wound should be kept clean and the gastro-intestinal tract should be considered as a possible source of infectious complications in severely burned patients.
- SDD is effective in preventing infections by eliminating pathogenic microorganisms from the gut and in blocking autocontamination of the burn wounds and translocation.